Adhesion, Lubrication, and Wear of Aluminum Surfaces

James B. Adams, Arizona State University, DMR Award # 0101840

Motivation: Wear processes are estimated to cost US industry over $8 billion/year, yet we still have only a limited understanding of how wear occurs on the atomic scale

Our Goal: Simulate wear events on the atomic scale, and determine how to reduce wear

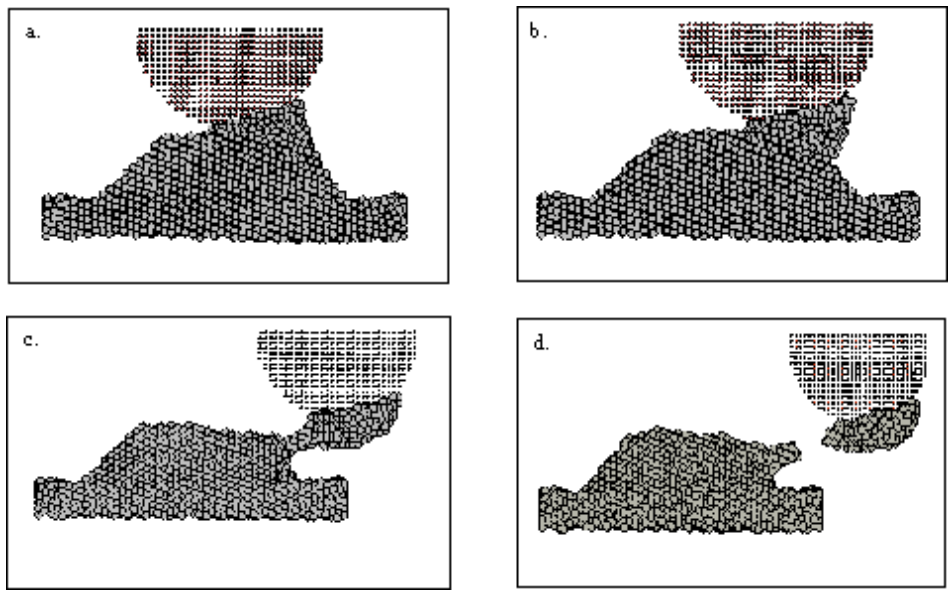
Our Accomplishments:

- Atomic-scale computer simulations of wear events, such as asperity-asperity shear
- Extensive study of adhesion between aluminum and a range of carbide, nitride, and oxide coatings

Technology Implications:

Based on our simulations, we have developed a new design criteria for selecting wear-resistant coatings. This new criteria will significantly simplify the search for new wear-resistant coatings for any materials application.

Fig. 1: Computer simulation of adhesive wear on the atomic scale, demonstrating how a hard asperity remove pieces of aluminum from an aluminum surface.



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Educational:

2 undergraduate students

3 graduate students (all spent summer internships with our collaborators at General Motors)

Collaborators:

L. Hector, General Motors

Y.T. Chang, General Motors

Outreach Activities:

Summer workshop for 25 middle and high school teachers (see photo)

Creation of TechGirl, a website designed to interest middle-school girls in science and engineering (http://techgirl.eas.asu.edu)

Middle and High School Science Teachers attend a 2-week workshop at ASU to learn about engineering. In this lab they work on several materials engineering projects with Prof. Adams, including making and testing concrete bars, investigating superconductivity, creating silly putty, and measuring fatigue of aluminum parts.